

CLAIMS

1. A method of detecting one of a set of preamble sequences in a spread signal comprising the steps of:

(a) correlating the received spread signal with sequences of a first orthogonal Gold code (OGC) set in accordance with a first fast transform to provide a preamble signal;

(b) correlating the preamble signal with the set of preamble sequences in accordance with a second fast transform to generate a set of index values;

(c) forming a decision statistic based on the set of index values; and

(d) selecting, as the detected one of the set of preamble sequences, a preamble sequence corresponding to the decision statistic.

2. The invention as recited in claim 1, wherein, for step (a), the first fast transform method is a fast orthogonal Gold code transform (FOGT) comprising the steps of

1) multiplying the received spread signal with a first sequence vector and a forward permutation vector to generate a permuted sequence signal, wherein:

the first OGC set is generated from the first sequence vector and a cyclic shift matrix of a second sequence vector, and the forward permutation vector maps between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard sequences; and

2) applying the fast Hadamaard transform to the permuted sequence signal to generate a set of correlated signals, the preamble signal selected as one of the set of correlated signals based on a predetermined decision criterion.

3. The invention as recited in claim 1, wherein:

for step (b), the set of preamble sequences are selected from a second OGC set formed from first and second sequence vectors, the second OGC set generated from the first sequence vector and a cyclic shift matrix of a second sequence vector; and wherein

the second fast transform is a fast orthogonal Gold code transform (FOGT) comprising the steps of

1) multiplying the preamble signal with a first sequence vector and a forward permutation vector to generate a permuted preamble signal, the forward permutation vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard sequences, and

2) applying the fast Hadamaard transform to the permuted preamble signal to generate the set of index values.

4. The invention as recited in claim 1, wherein, for step (b), the set of preamble sequences are selected from set of Walsh-Hadamaard sequences, and the second fast transform is a fast Hadamaard transform.

5. The invention as recited in claim 1, wherein, for step (a), the received spread signal is a burst of a random-access channel in a code-division, multiple-access communication system.

6. The invention as recited in claim 1, wherein step (c) comprises the steps of:

1) forming an initial decision statistic based on the relative maximum index of the set of index values;

2) selecting the signal generated by the preamble sequence combined with the preamble signal corresponding to the initial decision statistic;

3) adjusting, in one or more of amplitude and phase, the signal selected in step 2); and

4) forming the decision statistic based on the adjusted signal.

7. The invention as recited in claim 6, wherein step (c3) adjusts the selected signal by estimating a channel response from the preamble signal, forming a de-rotation signal from the preamble signal, and combining the de-rotation signal with the preamble signal for coherent sequence detection.

1 8. The invention as recited in claim 6, wherein step (c2) employs the initial
2 decision statistic to locally generate a corresponding preamble sequence, the locally
3 generated preamble sequence being combined with the preamble signal for coherent
4 sequence detection.

1 9. A method of detecting one of a set of preamble sequences in a spread
2 signal comprising the steps of:

3 (a) correlating the received spread signal with a set of orthogonal sequences to
4 provide a preamble signal;

5 (b) correlating the preamble signal with one or more preamble sequences of an
6 orthogonal Gold code (OGC) set in accordance with a fast transform to generate a set of
7 index values;

8 (c) forming a decision statistic based on the set of index values; and

9 (d) selecting, as the detected one of the set of preamble sequences, a preamble
10 sequence corresponding to the decision statistic.

1 10. The invention as recited in claim 9, wherein:

2 for step (b), each preamble sequence is selected from the OGC set formed from
3 first and second sequence vectors, wherein the OGC set is generated from the first
4 sequence vector and a cyclic shift matrix of a second sequence vector; and wherein

5 the fast transform is a fast orthogonal Gold code transform (FOGT) comprising
6 the steps of

7 1) multiplying the preamble signal with a first sequence vector and a forward
8 permutation vector to generate a permuted preamble signal, the forward permutation
9 vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard
10 sequences; and

11 2) applying the fast Hadamaard transform to the permuted preamble signal to
12 generate the set of index values.

1 11. A preamble detector for detecting one of a set of preamble sequences in a

2 spread signal, the preamble detector comprising:

3 a first correlator correlating the received spread signal with sequences of a first
4 orthogonal Gold code (OGC) set in accordance with a first fast transform to provide a
5 preamble signal;

6 a second correlator correlating the preamble signal with the set of preamble
7 sequences in accordance with a second fast transform method to generate a set of index
8 values;

9 a circuit forming a decision statistic based on the set of index values; and

10 a selector selecting, as the detected one of the set of preamble sequences, a
11 preamble sequence corresponding to the decision statistic.

1 12. The invention as recited in claim 11, wherein the first fast transform is a
2 fast orthogonal Gold code transform (FOGT), the first OGC set is generated from a first
3 sequence vector and a cyclic shift matrix of a second sequence vector, and the forward
4 permutation vector maps between i) the cyclic shift matrix and ii) a matrix of Walsh-
5 Hadamaard sequences; and wherein:

6 the first correlator comprises:

7 a multiplier multiplying the received spread signal with the first sequence
8 vector and a forward permutation vector to generate a permuted sequence signal;
9 and

10 a combiner applying the fast Hadamaard transform to the permuted
11 sequence signal to generate a set of correlated signals, the preamble signal
12 selected as one of the set of correlated signals based on a predetermined decision
13 criterion.

1 13. The invention as recited in claim 11, wherein:

2 the set of preamble sequences is selected from a second OGC set formed from
3 first and second sequence vectors, the second OGC set generated from the first sequence
4 vector and a cyclic shift matrix of a second sequence vector; and the second fast

transform is a fast orthogonal Gold code transform (FOGT); and wherein:

the second correlator comprises:

a multiplier multiplying the preamble signal with a first sequence vector and a forward permutation vector to generate a permuted preamble signal, the forward permutation vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard sequences, and

a combiner applying the fast Hadamaard transform to the permuted preamble signal to generate the set of index values.

14. The invention as recited in claim 11, wherein the set of preamble sequences is selected from a set of Walsh-Hadamaard sequences, and the second fast transform is a fast Hadamaard transform.

15. The invention as recited in claim 11, wherein the received spread signal is a burst of a random-access channel in a code-division, multiple-access communication system.

16. The invention as recited in claim 11, wherein the circuit forming the decision statistic comprises:

a first magnitude detector forming an initial decision statistic based on the relative maximum index of the set of index values;

a signal selector selecting the signal generated by the preamble sequence combined with the preamble signal corresponding to the initial decision statistic;

a coherent detector adjusting, in one or more of amplitude and phase, the signal selected in step 2); and

a second magnitude detector forming the decision statistic based on the adjusted signal.

17. The invention as recited in claim 16, wherein the coherent detector includes a channel estimator for i) estimating a channel response from the preamble signal, and ii) forming a de-rotation signal from the preamble signal, and a combiner for

4 combining the de-rotation signal with the preamble signal for coherent sequence
5 detection.

1 18. The invention as recited in claim 16, wherein the coherent detector
2 includes a sequence generator, the sequence generator employing the initial decision
3 statistic to locally generate a corresponding preamble sequence; and a combiner
4 combining the locally generated preamble sequence with the preamble signal for coherent
5 sequence detection.

1 19. The invention as recited in claim 11, wherein the preamble detector is
2 embodied in an integrated circuit.

1 20. A preamble detector for detecting one of a set of preamble sequences in a
2 spread signal comprising the steps of:

3 a first correlator correlating the received spread signal with a set of orthogonal
4 sequences to provide a preamble signal;

5 a second correlator correlating the preamble signal with one or more preamble
6 sequences of an orthogonal Gold code (OGC) set in accordance with a fast transform to
7 generate a set of index values;

8 a circuit forming a decision statistic based on the set of index values; and

9 a selector selecting, as the detected one of the set of preamble sequences, a
10 preamble sequence corresponding to the decision statistic.

1 21. The invention as recited in claim 20, wherein:

2 each preamble sequence is selected from the OGC set formed from first and
3 second sequence vectors, wherein the OGC set is generated from the first sequence vector
4 and a cyclic shift matrix of a second sequence vector and the fast transform is a fast
5 orthogonal Gold code transform (FOGT); and wherein

6 the second correlator comprises:

7 a multiplier multiplying the preamble signal with a first sequence vector and a
8 forward permutation vector to generate a permuted preamble signal, the forward

9 permutation vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-
10 Hadamaard sequences; and

11 a combiner applying the fast Hadamaard transform to the permuted preamble
12 signal to generate the set of index values.

1 22. The invention as recited in claim 20, wherein the preamble detector is
2 embodied in an integrated circuit.

1 23. A computer-readable medium having stored thereon a plurality of
2 instructions, the plurality of instructions including instructions which, when executed by
3 a processor, cause the processor to implement a method of detecting one of a set of
4 preamble sequences in a spread signal, the method comprising the steps of:

5 (a) correlating the received spread signal with sequences of a first orthogonal
6 Gold code (OGC) set in accordance with a first fast transform to provide a preamble
7 signal;

8 (b) correlating the preamble signal with the set of preamble sequences in
9 accordance with a second fast transform to generate a set of index values;

10 (c) forming a decision statistic based on the set of index values; and

11 (d) selecting, as the detected one of the set of preamble sequences, a preamble
12 sequence corresponding to the decision statistic.

1 24. The invention as recited in claim 23, wherein, for step (a), the first fast
2 transform method is a fast orthogonal Gold code transform (FOGT) comprising the steps
3 of

4 1) multiplying the received spread signal with a first sequence vector and a
5 forward permutation vector to generate a permuted sequence signal, wherein:

6 the first OGC set is generated from the first sequence vector and a cyclic
7 shift matrix of a second sequence vector, and the forward permutation vector
8 maps between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard
9 sequences; and

2) applying the fast Hadamaard transform to the permuted sequence signal to generate a set of correlated signals, the preamble signal selected as one of the set of correlated signals based on a predetermined decision criterion.

25. The invention as recited in claim 23, wherein:

for step (b), the set of preamble sequences are selected from a second OGC set formed from first and second sequence vectors, the second OGC set generated from the first sequence vector and a cyclic shift matrix of a second sequence vector; and wherein

the second fast transform is a fast orthogonal Gold code transform (FOGT) comprising the steps of

1) multiplying the preamble signal with a first sequence vector and a forward permutation vector to generate a permuted preamble signal, the forward permutation vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard sequences, and

2) applying the fast Hadamaard transform to the permuted preamble signal to generate the set of index values.

26. A computer-readable medium having stored thereon a plurality of instructions, the plurality of instructions including instructions which, when executed by a processor, cause the processor to implement a method of detecting one of a set of preamble sequences in a spread signal, the method comprising the steps of:

(a) correlating the received spread signal with a set of orthogonal sequences to provide a preamble signal;

(b) correlating the preamble signal with one or more preamble sequences of an orthogonal Gold code (OGC) set in accordance with a fast transform to generate a set of index values;

(c) forming a decision statistic based on the set of index values; and

(d) selecting, as the detected one of the set of preamble sequences, a preamble sequence corresponding to the decision statistic.

1 27. The invention as recited in claim 26, wherein:
2 for step (b), each preamble sequence is selected from the OGC set formed from
3 first and second sequence vectors, wherein the OGC set is generated from the first
4 sequence vector and a cyclic shift matrix of a second sequence vector; and wherein
5 the fast transform is a fast orthogonal Gold code transform (FOGT) comprising
6 the steps of
7 1) multiplying the preamble signal with a first sequence vector and a forward
8 permutation vector to generate a permuted preamble signal, the forward permutation
9 vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard
10 sequences; and
11 2) applying the fast Hadamaard transform to the permuted preamble signal to
12 generate the set of index values.

1 28. A transmitter in a code-division, multiple access communication system
2 generating data including a preamble sequence in a random access, burst channel, the
3 transmitter comprising a spreader combining the preamble sequence with a selected one
4 of a first set of orthogonal Gold code sequences.

1 29. The invention as recited in claim 28, wherein the preamble sequence is a
2 selected one of a second set of orthogonal Gold code sequences.